CLAIMS

What is claimed is:

1. An inspection system for coiled tubing being employed in a well, the system comprising:

an imaging device recording video signals of a segment of the coiled tubing as the coiled tubing is being employed into the well;

a conductor transmitting the video signals to a processor;

an image grabber generating an image of the tubing segment from the video signals; and

a program in the processor analyzing the image to detect predetermined features of the tubing segment.

2. The system of claim 1 further including means for generating longitudinal coordinates of the tubing segment.

3. The system of claim 2 wherein the longitudinal coordinates of the tubing are stamped on the image of the tubing segment.

4. The system of claim 1 wherein the video signals have a minimum resolution of 640 X 480 pixels with an 8 bit per pixel color or grayscale depth.

5. The system of claim 1 further including a video stacker stacking the images.

6. The system of claim 1 wherein the processor is programmed to recognize and classify the predetermined features on the tubing segment shown in the image.

7. The system of claim 1 wherein the predetermined features include one or more of the following: wear, cracks, patterns, abrasions, color, discolorations, or dimensions.

8. The system of claim 1 wherein the predetermined features include the diameter of the tubing.

9. The system of claim 1 wherein the processor generates a signal upon detecting a defect in the tubing so as to provide a warning of such defect.

10. A tubing for use with an automated defect inspection system comprising:

an outer wear layer; and

a contrasting layer beneath the wear layer;

wherein if the outer wear layer is worn away, the contrasting layer becomes visible as a contrasting feature on the tubing.

11. The tubing of claim 10, further comprising at least one stripe located on the outer wear layer and parallel to the longitudinal axis of the tubing.

12. The tubing of claim 11, wherein if more than one stripe is located on the outer wear layer, the stripes are individually distinguishable.

13. An inspection system comprising:

a composite coiled tubing having layers of fibers forming a tubing wall;

an outermost layer having a longitudinal stripe;

an imaging device recording video signals of a segment of the coiled tubing as the coiled tubing is presented before the imaging device;

a processor receiving the video signals from the imaging device; and

a program in the processor analyzing the video signals to detect the stripe on the tubing segment.

14. The system of claim 13 wherein the tubing has at least one outer layer having a predetermined color and the program analyzes the video signals to detect the predetermined color on the tubing segment.

15. An automated inspection system for identifying defects in coiled tubing, comprising:

a computer system configured to execute pattern recognition software; and

a plurality of imaging devices configured to capture video images of coiled tubing as the tubing passes in front of the imaging devices;

an image being transmitted to the computer system and the pattern recognition software analyzing the image, extracting features from the image, and generating a indication if a defect is identified in the image.

16. The inspection system of claim 15 wherein the imaging devices are fiber-optic imaging devices.

17. The inspection system of claim 15 wherein the plurality of imaging devices consist of three CCD cameras.

18. The inspection system of claim 15 further comprising:

a counter signal identifying a location along the coiled tubing; and

the computer system reading the counter signal to identify the location along the coiled tubing at which a defect is located.

19. The inspection system of claim 18 wherein if the counter signal indicates that the coiled tubing is not moving or moving slower than a threshold, the inspection system is disabled.

20. The inspection system of claim 18 wherein if the counter signal indicates that the coiled tubing is moving faster than the threshold, the inspection system is enabled.

21. The inspection system of claim 18 further comprising a video stacker configured to correlate video images taken from the plurality of imaging devices with one another as well as with a longitudinal position along the coiled tubing using the counter signal.

22. The inspection system of claim 15 wherein the video images are transmitted to the computer system for real time identification of defects.

23. The inspection system of claim 15 further comprising a video recorder configured to store the video images from the plurality of imaging devices for later defect identification.

24. The inspection system of claim 15 wherein the coiled tubing comprises at least one longitudinal stripe on the outer surface of the tubing as a reference for the purpose of identifying the annular location of a feature on the tubing.

25. The inspection system of claim 15 wherein the pattern recognition software further measures the outside diameter of the tubing and generates an indication if the diameter is outside a user-designated tolerance range.

26. A computer system for use in an automated tubing inspection system comprising:

a processor;

at least one output device;

an input device configured to receive video signals and generate sequential images from the video input;

a pattern classification software program configured to read the images and extract features from the images and compare the size of these features against user-defined thresholds;

wherein if the pattern classification software determines that the size of the features does not fall within the user-defined threshold, the software generates an interrupt indicating that a defect has been located.

28. The computer system of claim 27 further comprising:

an input for receiving location data indicating the position from which the incoming images are taken;

wherein when the pattern classification software generates the warning interrupt, the computer system transmits the image containing the defect and the corresponding location data to the output device.

29. The computer system of claim 28 wherein the output device is a printer.

30. The computer system of claim 28 wherein the output device is a monitor.

31. The computer system of claim 28 wherein the pattern classification software may be trained to recognized unwanted defects and ignore innocuous features.

32. A method of identifying defects in a continuous length of coiled tubing, comprising:

passing the continuous length of coiled tubing in front of a plurality of imaging devices;

capturing images of the outer circumference of the tubing with the imaging devices and transmitting the images to a processor;

receiving the images by the processor and inputting the images to computer vision software running on the processor; and

processing the images on the computer vision software; and

identifying predetermined features in the tubing.

33. The method of claim 32 further including initiating a warning event upon detecting a defect in the tubing.

34. The method of claim 32 wherein the passing step includes guiding the coiled tubing through a guide roller mechanism as the tubing is spooled on or off a storage reel and placing the aperture of a plurality of imaging devices in close proximity to the guide roller mechanism.

35. The method of claim 32, further comprising:

transmitting a depth counter value the processor to identify the position along the tubing at which the images are taken; and

displaying the image of the features.

36. The method of claim 35 further including indicating the position of a defect in the tubing.

37. The method of claim 32, further comprising:

specifying the annular location of a predetermined feature with respect to an annular reference established by at least one longitudinal stripe located on the outer diameter of the tubing; and

indicating the annular position of the predetermined features.

38. The method of claim 32, further comprising transmitting power to operate the imaging devices and transmitting light to illuminate the tubing.

39. The method of claim 32, wherein the imaging devices are located on a levelwind that is coupled to a reel on which the tubing is coiled.

40. The method of claim 32, further comprising storing the images on recordable media prior to processing the images.

41. The method of claim 40, further comprising storing the images with the depth counter value.

42. The method of claim 32, further comprising identifying a feature as a defect by determining if the size of an unrecognized feature exceeds a user-designated threshold.

43. The method of claim 32, further comprising identifying a feature as a defect by determining if the size of a previously recognized defect has grown beyond a user-designated percentage of its original size.